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ABSTRACT

Restatements of the educational standards and the science competencies established by the New Mexico State Board of Education are provided in this document. Identified as basic and process skills, these checkpoint competencies are tied directly to the exit competencies for science. It is suggested that the checkpoint competencies be used as a framework in developing a written and delivered curriculum and be aimed at the ultimate mastery of the exit competencies. The exit level competencies as well as the third, fifth, and eighth grade competency checkpoints are listed and classified into 13 major skill areas. These include the processes of: (1) observing; (2) classifying; (3) inferring; (4) predicting; (5) measuring; (6) communicating; (7) interpreting data; (8) making operational definitions; (9) formulating questions and hypotheses; (10) experimenting; (11) modeling; (12) using quantitative applications; and (13) recognizing impact. (ML)

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NEW MEXICO

STATE DEPARTMENT OF EDUCATION

SCIENCE COMPETENCIES

FOR EXIT LEVEL

and

CHECKPOINT COMPETENCIES

FOR LEVELS 3,5,&8

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1985

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INTRODUCTION

The society in which we live is greatly affected by science and technology. The converse is also true, that is, science and technology are affected by our present day society. The ideas and concepts from basic scientific research become useful products for society through technology. The society must reach into its pocketbook for funds to support science and technology. In this mutualistic arrangement, the students become the link in the chain, entering as school children and emerging as either citizen scientists or citizen advocates of science. As in any chain where links fail to carry out their tasks, the chain fails.

Exit Competencies

The State Board of Education has assumed its responsibility in providing Educational Standards that state science competencies required of students upon leaving high school for post-high school education or for less formal educational experiences. The purpose of this publication is to restate those competencies and to provide school districts and science teachers with checkpoint competencies that lead to eventual mastery of those exit competencies. The development of written and delivered curriculum will be facilitated through the use of the contents of this document.

Checkpoint Competencies

The competency checkpoints included herein are tied directly to the exit competencies for science, which are basic and process skills, as required by Educational Standards. The checkpoint competencies are basic and process skill directed, similar to the exit competencies.

Conceptual development has been initiated at the elementary level and should be continued through middle or junior high school. Skill development should be the other component of the delivered curriculum. The skills and competencies are many of the same skills used in other content areas. One cannot teach reading, social studies, mathematics, physical education, or art without teaching the skills of observing, classifying, predicting, inferring, and communicating. Those fundamental skills of science are the basis of competencies in this document. Research indicates that children who are engaged in the hands-on activities of a quality science education program exhibit greater competence in other content areas than those children whose experience in science is passive. These skill competencies help educators develop the whole child.

The checkpoint competencies may be used in a variety of ways. It should be made clear at the outset, however, that they are suggestions for skill development aimed at the ultimate mastery of the exit competencies. There may be competencies listed herein that are not consistent with the thought of local districts. It is hoped that comparable local competencies will be developed which will also lead to mastery. These checkpoints are designated because

science is a process as well as a content discipline. At the middle or junior high school course sequences are subject to school organizational plans, teacher preference for teaching a particular subject or teaching preparation, any or all of which may dictate subjects to be taught. In any event, skills must be an integral part of any science program and the content, whatever it may be, is the vehicle by which the skills are learned and mastered.

Strategies

Teaching strategies for science at any level should include problem solving, inquiry, many hands-on activities, learning experiences out of the classroom and a responsible approach to making science awareness a part of each child's education. Strategies should also emphasize the value of science and its processes in other content areas of study. Children have an innate curiosity about their surroundings. Science is an excellent vehicle to capture the attention of children and to let them explore the vast expanse of knowledge and experiences. It will permit them to satisfy their natural curiosities about nature and the nature of things.

Evaluation

The Science Education Advisory Committee first formulated these competencies and checkpoints. The level designated for checkpoints coincides with placement of the statewide testing program which uses CTBS. However, the CTBS is independent of the checkpoints and does not test the skills approach that is found in the competencies. One may wonder how the exit competencies might be evaluated and how teachers will know when their students have acquired the skills and knowledge deemed essential at the various checkpoints. The Educational Standards require that the delivered curriculum and written curriculum be congruent and that provisions be made for assessing student progress during the program as well as after instruction. Student progress and program assessment are the responsibility of the district. Should a district seek help in developing an assessment and evaluation design based on the competencies, State Department of Education personnel will offer assistance.

Science Education Advisory Committee Recommendations

The Science Education Advisory Committee has presented the State Board of Education with several recommendations and a definition of a laboratory science.

The recommendations include an emphasis on an investigative approach to science teaching/learning with many hands-on experiences. This strategy is applicable with all levels of students and with an increasingly open-ended approach as the students' maturation levels rise.

A condition that currently is in place in the Educational Standards is the requirement of only one (1) laboratory science for graduation. The Science Education Advisory Committee has recommended to the State Board of Education that three (3) units of laboratory science be required and that there be at least one unit in each of the life and physical sciences.

Other recommendations, all of which are just that at this time, include proper recruitment and preparation of science teachers at elementary/secondary levels, and proper design, construction and equipping of science instructional areas.

Format And Use Of The Competencies

The format of these competency statements is such that the major skill competency areas are identified with dark type. The sections of lighter type identify the suggested checkpoint competencies at the level indicated in that section of the publication.

These checkpoint competencies are only suggestions and indicators to be used in developing written and delivered curriculum. There is no particular sequence other than some of the skills are more basic than others (observing, classifying, predicting, inferring, measuring, and communicating). The other skill areas require a higher order of thinking and are more appropriate at intermediate and above levels.

The bank of checkpoint competencies has been reviewed by the members of the Science Education Advisory Committee and several reviewers from schools across the state (see the acknowledgements section). Since no publication of this kind is perfect at first effort, comments and suggestions are invited by those using this document. It is hoped that those feeling the need to revise competencies listed will be willing to offer, in writing, suggestions for changes. Such suggestions are welcome and hopefully the instrument that results from this type of input will be a better guide to science education teachers.

ABOUT THE COMPETENCIES

Some suggested activities appear in more than one set or level of checkpoints. This is to be expected since they lead toward mastery of an exit competency and there will be some repetition of skill development. A student at one level of maturation will repeat skills at a later age demonstrating competence with more sophisticated activities. Because the activities are listed at several levels, they will ensure that students have opportunities to demonstrate competence at a variety of levels of mastery.

For example, a third grade student may be asked to separate sand from rocks by size of particles given. A student at fifth grade may be given the task of separating the various sized particles of sand and may have to resort to more sophisticated processes in order to do the task, processes involving some equipment which the third grader could not use.

The competency checkpoint suggested activities may seem to some to be too numerous and perhaps too difficult for the levels addressed. However, teachers are encouraged to challenge their students to engage in these activities and determine what students can really do.

It is apparent that the skills and competencies are not learned in isolation from other skills. For example, a student observes several objects, determines that they have some different properties and some similar properties. The student is then able to develop a classification system for those objects based on their properties. Further, the student should be able to communicate to the teacher and/or others the basis for classifying the objects in the manner chosen. Thus, three of the basic skills are utilized in one activity.

EXIT LEVEL COMPETENCIES*

A. OBSERVING

THE STUDENT SHALL:

1. DESCRIBE OBJECTS AND EVENTS ON THE BASIS OF OBSERVABLE CHARACTERISTICS.

2. USE INDIRECT METHODS IF DIRECT SENSE EXPERIENCE IS INSUFFICIENT TO DESCRIBE OBJECTS OR EVENTS.

3. DESCRIBE AND REPORT DATA QUANTITATIVELY.

4. DISTINGUISH BETWEEN OBSERVATIONS AND INFERENCE.

B. CLASSIFYING

THE STUDENT SHALL:

1. CLASSIFY OBJECTS AND EVENTS BASED ON OBSERVABLE SIMILARITIES AND DIFFERENCES OF SELECTED PROPERTIES.

2. USE CLASSIFICATION KEYS TO PLACE ITEMS WITHIN A SCHEME OR TO RETRIEVE INFORMATION FROM A SCHEME.

3. CONSTRUCT TWO OR MORE CLASSIFICATION SCHEMES FOR THE SAME SET OF OBJECTS AND DEVELOP A CLASSIFICATION SYSTEM.

C. INFERRING

THE STUDENT SHALL:

1. DRAW LOGICAL CONCLUSIONS OR INTERPRETATIONS OF EVENTS BASED ON GIVEN DATA OR PREMISES.

D. PREDICTING

THE STUDENT SHALL:

1. SUGGEST THE OUTCOME OF AN EVENT BASED UPON PREVIOUSLY OBSERVED CONDITIONS.

*These are the required school exit level competencies which are also listed in EDUCATIONAL STANDARDS FOR NEW MEXICO SCHOOLS.

2. SUGGEST CAUSE AND EFFECT RELATIONSHIPS WITHIN A SCIENTIFIC PROBLEM SOLVING SITUATION.

E. MEASURING

THE STUDENT SHALL:

1. MEASURE PROPERTIES OF OBJECTS OR EVENTS BY DIRECT COMPARISON WITH STANDARDIZED UNITS OF MEASUREMENT.

2. STATE THE PARAMETERS OF A DESIGNATED MEASUREMENT.

F. COMMUNICATING

THE STUDENT SHALL:

1. KEEP ACCURATE RECORDS OF OBSERVATIONS.

2. CONSTRUCT A SIMPLE DATA TABLE CONTAINING TWO VARIABLES, AND LABEL COLUMNS, ROWS, AND ACCURATELY ENTER DATA.

3. MAKE GRAPHIC REPRESENTATIONS OF ACCUMULATED RECORDS OF OBSERVATION AND COMMUNICATE THIS INFORMATION CLEARLY AND MEANINGFULLY.

4. CONSTRUCT A SIMPLE BAR GRAPH PROPERLY LABELED AND SCALED.

5. DEMONSTRATE TECHNICAL WRITING SKILLS.

G. INTERPRETING DATA

THE STUDENT SHALL:

1. USE PROCESSES SUCH AS CLASSIFYING, PREDICTING, INFERRING, AND COMMUNICATING TO INTERPRET DATA.

2. REVISE INTERPRETATIONS OF DATA BASED ON NEW INFORMATION OR REVISED DATA.

3. FORMULATE CONCLUSIONS WHEN GIVEN APPROPRIATE DATA, TABLES, AND GRAPHS.

4. ABSTRACT IMPORTANT IDEAS FROM READING, LISTENING, OR WATCHING A PRESENTATION.

H. MAKING OPERATIONAL DEFINITIONS

THE STUDENT SHALL:

1. DESCRIBE A VARIABLE OR EVENT IN OBSERVABLE AND MEASURABLE TERMS TO DIFFERENTIATE INFORMATION FROM OTHER PHENOMENA.

I. FORMULATING QUESTIONS AND HYPOTHESES

THE STUDENT SHALL:

1. STATE QUESTIONS ON THE BASIS OF OBSERVATIONS.

2. DEVISE A STATEMENT WHICH CAN BE TESTED BY EXPERIMENT.

3. CONSTRUCT HYPOTHESES FROM INFORMATION GIVEN IN A DATA TABLE, GRAPH, OR PICTURE.

4. REVISE HYPOTHESES BASED ON NEW INFORMATION.

J. EXPERIMENTING

THE STUDENT SHALL:

1. DESIGN DATA-GATHERING PROCEDURES AS WELL AS TEST A HYPOTHESIS.

2. CONDUCT SIMPLE EXPERIMENTS TO MAKE OBSERVATIONS OR TO CONFIRM A PREDICTION.

3. BE ABLE TO IDENTIFY THE VARIABLES AND CONTROL ASPECTS OF AN EXPERIMENT.

4. CONSIDER LIMITATIONS OF METHODS AND APPARATUS OF EXPERIMENTATION.

5. DEMONSTRATE LABORATORY SAFETY PROCEDURES.

6. DEMONSTRATE ERROR ANALYSIS AND INFORMATION ANALYSIS.

K. MODELING

THE STUDENT SHALL:

1. DEVISE MODELS ON THE BASIS OF AN ACCEPTABLE HYPOTHESIS OR HYPOTHESES THAT HAVE YET TO BE TESTED.

2. USE MODELS TO DESCRIBE AND EXPLAIN INTERRELATIONSHIPS OF IDEAS.

3. USE A MODEL TO VISUALIZE THE SOLUTION TO A PROBLEM.

L. USING QUANTITATIVE APPLICATIONS

THE STUDENT SHALL:

1. REPRESENT SCIENTIFIC PRINCIPLES USING MATHEMATICAL FORMAT.

2. RECORD MEASUREMENT USING APPROPRIATE SCIENTIFIC NOTATION.

3. IDENTIFY AND DEMONSTRATE A RELATIONSHIP BETWEEN TWO VARIABLES THAT CAN BE USED TO MAKE A PREDICTION.

4. READ AND INTERPRET NUMERICAL VALUES FROM CHARTS, TABLES OR GRAPHS, AND APPLY RESULTS TO ANSWERING QUESTIONS.

M. RECOGNIZING IMPACT

THE STUDENT SHALL:

1. IDENTIFY, DESCRIBE, AND DISCUSS CONTEMPORARY ISSUES IN SCIENCE, SUCH AS FAMILY PLANNING, PATTERNS OF SOCIALLY TRANSMITTED DISEASE, GENETIC ENGINEERING, PESTICIDES, NUCLEAR ENERGY, AND POLLUTION AS THEY RELATE TO HUMANS.

2. RECOGNIZE THE ROLE OF THE POLITICAL PROCESS IN THE ADVANCEMENT OF SCIENCE.

3. DESCRIBE THE EFFECTS OF SCIENCE IN: CONSUMERISM, SAFETY, CAREERS, COMPUTERS, SOLAR ENERGY, SYNTHETIC FUELS, AND FOSSIL FUELS.

4. RECOGNIZE THE LIMITATIONS OF SCIENCE.

5. RECOGNIZE THE IMPACT OF THE ACCUMULATION OF NEW EVIDENCE ON SCIENTIFIC THOUGHT.

6. RECOGNIZE HOW THE CONTRIBUTIONS OF SCIENCE LEAD TO THE DEVELOPMENT OF NEW IDEAS.

7. RECOGNIZE THE TRUTH SEEKING NATURE OF SCIENCE.

THIRD, FIFTH, AND EIGHTH GRADE
SCIENCE COMPETENCIES

A. Observing. The student shall:

1. Describe objects and events on the basis of observable characteristics.

Third Grade	Fifth Grade	Eighth Grade
a. Make observations in a variety of ways using all of the senses.	a. Make observations in a variety of ways using all of the senses.	a. Make observations in a variety of ways using all of the senses.
b. Describe a situation, event or life form using more than one of the senses.	b. Distinguish between qualitative and quantitative observations.	b. Distinguish between qualitative and quantitative observations.
	c. Write an accurate and documented paper describing events.	

2. Use indirect methods if direct sense experience is insufficient to describe objects or events.

Third Grade	Fifth Grade	Eighth Grade
a. Determine dimensional characteristics of an object that is not visible.	a. Describe an object by the size of its shadow.	a. Identify causes of sounds produced by unseen objects.
	b. Describe length, mass, volume of irregular objects by seeing and feeling only.	b. Describe the texture of various substances.

3. Describe and report data quantitatively.

Third Grade	Fifth Grade	Eighth Grade
a. Make quantitative observations to accumulate precise data.	a. Make quantitative observations to accumulate precise data.	a. Make quantitative observations to accumulate precise data.
b. After measuring each object arrange the group of objects from tallest to shortest, heaviest to lightest.	b. Identify objects as one, two, or three dimensional.	b. Compare properties of two or more objects.
c. State observations in quantitative terms using more than one of the senses.	c. Sequence the stages of events according to order of occurrence.	
	d. Identify observations which describe changes in properties of an object.	
	e. Make an accurate count of a given set of objects.	

*The statements in dark type are the required school exit level competencies and are also listed in Educational Standards for New Mexico Schools.

**All examples are to be used only as guidelines for further local clarification of competency statements.

A. Continued

4. Distinguish between observations and inference.

Third Grade	Fifth Grade	Eighth Grade
a. Identify observations that support an inference.	a. Identify observations that support an inference.	a. Identify the senses used in making an observation.
	b. Identify observations on which a stated inference has been made.	
	c. Differentiate between actual observations and personal interpretations.	

B. **Classifying. The student shall:**

1. **Classify objects and events based on observable similarities and differences of selected properties.**

Third Grade	Fifth Grade	Eighth Grade
a. Sort a set of objects according to similarities and differences.	a. Sort a set of objects according to similarities and differences. b. Classify similar objects by particle size. c. Use quantitative measurements as criteria for grouping.	a. Classify objects on the basis of observations. b. Group similar objects on the basis of quantitative properties.

2. **Use classification keys to place items within a scheme or to retrieve information from a scheme.**

Third Grade	Fifth Grade	Eighth Grade
a. Use a binary classification system to classify objects. b. Construct a classification system to identify animals.	a. Group specimens into classes when given examples.	a. Use a dichotomous key to classify objects/phenomena.

3. **Construct two or more classification schemes for the same set of objects and develop a classification system.**

Third Grade	Fifth Grade	Eighth Grade
a. Develop classification system that includes several potentially common properties of objects.	a. Develop classification system that includes several potentially common properties of objects.	a. Develop classification system that includes several potentially common properties of objects. b. Demonstrate the use of time to classify events.

C. Inferring. The student shall:

1. Draw logical conclusions or interpretations of events based on given data or premises.

Third Grade	Fifth Grade	Eighth Grade
a. Make evaluations and judgements based on observations.	a. Make evaluations and judgements based on observations.	a. Make evaluations and judgements based on observations.
b. Formulate an expected result based on past experience.	b. Formulate an expected result based on past experiences.	b. Formulate an expected result based on past experience.
c. Given specific information about an event, make a series of inferences.	c. Draw inferences about interdependence based on field observations.	c. Describe additional observations needed to test alternative inferences.
d. Recognize that two people may make different inferences from the same observation and neither be wrong.	d. Identify observations that support or do not support an inference.	d. Identify observations that support or do not support an inference.
e. Identify observations that support an inference.	e. Describe additional observations needed to test alternative inferences.	
	f. Construct a test of an inference or hypothesis.	

D. **Predicting. The student shall:**

1. **Suggest the outcome of an event based upon previously observed conditions.**

Third Grade	Fifth Grade	Eighth Grade
a. Confirm a prediction through an experiment.	a. Confirm a prediction through an experiment.	a. Confirm a prediction through an experiment.
b. Make predictions based on observations of events or patterns.	b. Interpolate or extrapolate conclusions when given appropriate data, tables, and graphs.	

2. **Suggest cause and effect relationships within a scientific problem solving situation.**

Third Grade	Fifth Grade	Eighth Grade
a. Given a set of conditions, make a prediction based on knowledge of the conditions.	a. Order a set of predictions in terms of confidence in them.	a. Predict the consequences of removing or altering one or more components in a system.
	b. Predict the consequences of removing or altering one or more components in a system.	b. Construct tests for a prediction.
	c. Construct tests for a prediction.	

E. **Measuring. The student shall:**

1. **Measure properties of objects or events by direct comparison with standardized units of measurement.**

Third Grade	Fifth Grade	Eighth Grade
a. Use International System of units (SI) or acceptable units as an appropriate measure of linear distance, temperature and time.	a. Use International System of units (SI) or acceptable units as the appropriate measure of linear distance, temperature, time, electrical charge and mass.	a. Use International System of units (SI) or acceptable units as the appropriate measure of linear distance, temperature and time.
b. Express the basic units of measurement.	b. Quantify information through the use of graphs, diagrams, and other visual aids.	b. Use International System of units (SI) or acceptable units as the appropriate measure of volume, mass, and angle.
c. Quantify information through the use of graphs, diagrams, and other visual aids.	c. Use International System of units (SI) or acceptable units as the appropriate measure of area, volume, angle, velocity, and density.	c. Estimate the length and mass of common environmental objects using International System of units (SI).
d. Measure forces with balances, springs, and other appropriate devices.	d. Estimate the length and mass of common environmental objects using International System of units (SI) or acceptable units.	d. Use appropriate derived units for specific measurements.

2. **State the parameters of a designated measurement.**

Third Grade	Fifth Grade	Eighth Grade
a. Select the appropriate tool for measurements to be made.	a. Select the appropriate tool for measuring various physical properties of objects.	a. Select the appropriate tool for measuring various physical properties of objects.
	b. From measurable characteristics, provide quantitative values in the description of physical phenomena.	b. Record measurement using appropriate scientific notation.
		c. Demonstrate knowledge of how instruments are calibrated using units of a known quantity.
		d. Distinguish between accuracy and precision.
		e. Demonstrate the concept of significant figures.

F. Communicating. The student shall:

1. **Keep accurate records of observations for checking and rechecking others.**

Third Grade	Fifth Grade	Eighth Grade
a. Describe surfaces by color, shape, and texture.	a. Describe surfaces by color, shape, and texture.	a. Record observations of changing phenomena.
b. Describe a series of events.	b. Record accurately the sequence of events in an experiment.	
c. Describe observed changes in properties of objects.		

2. **Construct a simple data table containing two variables, label columns and rows, and accurately enter data.**

Third Grade	Fifth Grade	Eighth Grade
a. Demonstrate the ability to properly name the manipulated and the responding variables in a data table.	a. Demonstrate the ability to properly name the manipulated and the responding variables in a data table.	a. Demonstrate the ability to properly name the manipulated and the responding variables in a data table.
b. From an investigation involving two variables, construct a data table of the ordered pairs.	b. From an investigation involving two variables, construct a data table of the ordered pairs.	b. From an investigation involving two variables, construct a data table of the ordered pairs.

3. **Make graphic representations of accumulated records of observations and communicate this information clearly and meaningfully.**

Third Grade	Fifth Grade	Eighth Grade
a. Demonstrate knowledge of the components of the types of graphs, i.e., bar graph, line graph, and pie graph.	a. Demonstrate knowledge of the components of the types of graphs, i.e., bar graph, line graph, and pie graph.	a. Demonstrate knowledge of the components of the types of graphs, i.e., bar graph, line graph, and pie graph.
b. Demonstrate ability to transfer information from a data table to an appropriate graph form.	b. Demonstrate ability to transfer information from a data table to an appropriate graph form.	b. Demonstrate ability to transfer information from a data table to an appropriate graph form.
c. Demonstrate ability to interpret information on a graph.	c. Demonstrate ability to interpret information on a graph.	c. Demonstrate ability to interpret information on a graph.

F. Continued

4. Construct a simple bar, line and/or pie graph properly labeled and scaled.

Third Grade	Fifth Grade	Eighth Grade
a. From an investigation involving manipulated and responding variables, construct a line graph of the data.	a. Construct a simple line graph which has at least four (4) sets of coordinates and label all scales and axes.	a. Construct a simple line graph which has at least four (4) sets of coordinates and label all scales and axes.
	b. Construct a bar graph from data on a data table.	b. Communicate information between data points on line and bar graphs.

5. Integrate written work with subject matters to improve technical writing skills.

Third Grade	Fifth Grade	Eighth Grade
a. State a rule about data from a graph of data table.	a. Describe a series of events in writing.	a. Write an accurate and documented paper describing events.
	b. Sequence the stages of events according to order of occurrence.	

G. **Interpreting Data. The student shall:**

1. **Use processes such as classifying, predicting, inferring, and communicating to interpret data.**

Third Grade	Fifth Grade	Eighth Grade
a. Interpret the data represented on a bar graph.	a. Communicate supporting data for inference or prediction.	a. Communicate supporting data for inference or prediction.
b. Interpret the data represented on a line graph.	b. Interpret cause and effect relationships within a scientific problem solving situation.	b. Interpret cause and effect relationships within a scientific problem solving situation.
	c. Read and interpret numerical values from charts, tables or graphs, and apply results to answering questions.	c. Read and interpret numerical values from charts, tables or graphs, and apply results to answering questions.

2. **Revise interpretations of data based on new information or revised data.**

Third Grade	Fifth Grade	Eighth Grade
a. Determine the effect of changing values on a bar and/or line graph.	a. Examine biases and how they can affect/distort data.	a. Examine biases and how they can affect or distort data.
	b. Recognize alternative factors to be considered when examining possible solutions to a problem.	b. Recognize alternative factors to be considered when examining possible solutions to a problem.
	c. Demonstrate an open-minded and imaginative approach to problem solving.	c. Demonstrate an open-minded and imaginative approach to problem solving.
		d. Deduce cause and effect relationships from given data.

G. Continued

3. **Formulate conclusions when given appropriate data, tables, and graphs.**

Third Grade	Fifth Grade	Eighth Grade
a. Interpolate or extrapolate conclusions when given appropriate data, tables, and graphs.	a. Identify inferences that should be accepted, rejected, or modified on the basis of additional observations.	a. Interpolate or extrapolate conclusions when given appropriate data, tables, and graphs.
	b. Construct one or more inferences or hypotheses from the information given in a table of data, graphs, or pictures.	b. Identify inferences that should be accepted, rejected, or modified on the basis of additional observations.
		c. Construct one or more inferences or hypotheses from the information given in a table of data, graphs, or pictures.
		d. Interpret the information provided by the shape of a graph.

4. **Abstract important ideas from reading, listening to or watching a presentation.**

Third Grade	Fifth Grade	Eighth Grade
a. Identify the main thought of a given paragraph.	a. Distinguish between relevant and irrelevant data.	a. Distinguish between relevant and irrelevant data.
b. Identify the principle emphasized in a given demonstration.	b. Recognize the meaning of selected terms used in the field of physical science.	b. Recognize the meaning of selected terms used in the field of physical science.
c. Identify evidence of inter-dependence in living systems.	c. Interpret change and equilibrium as a dynamic interaction.	
	d. Recognize and describe systems in equilibrium.	

H. **Making Operational Definitions. The student shall:**

1. **Describe a variable or event in observable and measurable terms to differentiate information from other phenomena.**

Third Grade	Fifth Grade	Eighth Grade
a. Distinguish between operational and non-operational definitions.	a. Distinguish between operational and non-operational definitions.	a. Distinguish between operational definitions and non-operational definitions.
	b. Explain physical requirements under which an experiment must operate.	b. Define observed phenomena to differentiate this information from other phenomena.
	c. Define observed phenomena to differentiate this information from other information.	c. Identify variables or words for which an operational definition is needed, given a problem, hypothesis, inference, question, graph, or table of data.

I. **Formulating Questions and Hypotheses. The student shall:**

1. **State questions on the basis of observations.**

Third Grade	Fifth Grade	Eighth Grade
a. Demonstrate questioning techniques when observing a phenomena.	a. Apply appropriate questions when a problem is stated.	a. Apply appropriate questions when a problem is stated.
	b. Establish criteria by which a solution will be judged.	b. Establish criteria by which a solution will be judged.
		c. Represent scientific principles using mathematical format.

2. **Devise a statement which can be tested by experiment.**

Third Grade	Fifth Grade	Eighth Grade
a. Generate more questions or problems to be solved through application of other processes of science.	a. Distinguish between hypotheses and problems.	a. From observations of a phenomena, construct a statement to be verified by an investigation.
	b. Distinguish among opinion, hypothesis, theory, and law.	
	c. Read and analyze advertisements and other commercial messages for inferences, half-truths, and emotional appeals.	

3. **Construct hypotheses from information given in a data table, graph, or picture.**

Third Grade	Fifth Grade	Eighth Grade
a. Devise a statement which is a generalization of observations and/or inferences.	a. Transfer known information into a familiar representation which clearly shows the path to the solution.	a. Distinguish among opinion, hypothesis, theory, and law.
	b. Identify hypotheses based on data.	b. Identify hypotheses based on data.
	c. Collect, group, analyze, regroup, and synthesize information relative to a problem.	

I. Continued

4. **Revise hypotheses based on new information.**

Third Grade	Fifth Grade	Eighth Grade
a. Following an investigation that does not verify a prediction, restate the hypothesis.	a. Propose alternative strategies to the solution of a problem.	a. Identify conditions that cause or influence a change in variables.
	b. Identify alternative courses of action which may result in a solution to the problem.	b. Determine which variables should be manipulated to investigate a given situation.
	c. Distinguish between observations that support a hypothesis and those that do not.	c. Distinguish between observations that support an hypothesis and those that do not.
	d. Revise a hypothesis based upon observations of the test.	d. Revise a hypothesis based upon observations of the test.
		e. Collect, group, analyze, regroup, and synthesize information relative to a problem.
		f. Identify and demonstrate a relationship between two variables that can be used to make a prediction.
		g. Transform known information into a familiar representation which clearly shows the path to the solution.

J. **Experimenting. The student shall:**

1. **Design data gathering procedures as well as test an hypothesis.**

Third Grade	Fifth Grade	Eighth Grade
a. Construct a problem involving variables and carry out an investigation which tests those variables.	a. Construct a problem involving variables and carry out an investigation which tests those variables.	a. Construct and demonstrate a test of a hypothesis.

2. **Conduct simple experiments to make observations or to confirm a prediction.**

Third Grade	Fifth Grade	Eighth Grade
a. Manipulate scientific materials and equipment appropriate to grade level.	a. Manipulate scientific materials and equipment appropriate to grade level.	a. Suggest appropriate experiments to solve simple problems.
b. Properly care for scientific equipment and scientific materials.	b. Properly care for scientific equipment.	b. Recognize and define a problem, then formulate a research question.
c. Assemble equipment appropriate for investigation.	c. Construct or assemble equipment appropriate for investigation.	c. Recognize solutions to simple problems and appropriately modify an effective solution.
d. Associate the names and functions of science equipment.	d. Associate the names and functions of science equipment.	d. Design, conduct, and report on an experiment involving all the science processes when appropriate.

3. **Be able to identify variables and the control aspects of an experiment.**

Third Grade	Fifth Grade	Eighth Grade
a. Identify the value of controlled variables in an experiment.	a. Identify variables which are manipulated or responded to, and constants in an investigation or an experiment.	a. Identify variables which are manipulated or responded to, and constants in an investigation or an experiment.

J. Continued

4. **Consider limitations of methods and apparatus of experimentation.**

Third Grade	Fifth Grade	Eighth Grade
a. Identify the extent to which an experiment may be carried out.	a. Distinguish between observations that support a hypothesis and those that do not.	a. Distinguish between observations that support an hypothesis and those that do not.
b. Choose science equipment appropriate for tasks.	b. Choose science equipment appropriate for tasks.	b. Revise a hypothesis based upon observations of the test.
	c. Revise a hypothesis based upon observations of the test.	c. Recognize and list limitations which influence conclusions.
		d. Recognize the elements of good experimental design (problem, hypothesis, data, purpose, method, and conclusion).

5. **Demonstrate lab safety procedures.**

Third Grade	Fifth Grade	Eighth Grade
a. Employ safe laboratory procedures and practices.	a. Employ safe laboratory procedures and practices.	a. Employ safe laboratory procedures and practices.

6. **Demonstrate error analysis and information analysis.**

Third Grade	Fifth Grade	Eighth Grade
a. Describe sources of error in a measurement.	a. Describe sources of error in a measurement.	a. Describe sources of error in a measurement.
		b. Demonstrate the compounding of error in measurement in final computations.

K. Modeling. The student shall:

1. Devise models on the basis of an acceptable hypothesis or hypotheses that have yet to be tested.

Third Grade	Fifth Grade	Eighth Grade
a. Devise models on the basis of data derived from observations, inferences, or experiments.	a. Devise models on the basis of data derived from observations, inferences, or experiments.	a. Devise models on the basis of data derived from observations, inferences, or experiments. b. Describe the limitations of scientific models.

2. Use models to describe and explain interrelationships of ideas.

Third Grade	Fifth Grade	Eighth Grade
a. Develop a physical model of an object, given sufficient data about the object.	a. Develop a physical model of an object, given sufficient data about the object.	a. Develop a physical model of an object, given sufficient data about the object. b. Develop a mental model of an event or sequence of events.

3. Use a model to visualize the solution to a problem.

Third Grade	Fifth Grade	Eighth Grade
a. Demonstrate the use of prepared models to explain phenomena.	a. Demonstrate the use of prepared models to explain phenomena.	a. Demonstrate the use of prepared models to explain phenomena. b. Use analogies to identify the elements of a problem as parts of a more complex situation.

L. **Using Quantitative Applications. The student shall:**

1. **Represent scientific principles using mathematical format.**

Third Grade	Fifth Grade	Eighth Grade
a. Express large and small quantities numerically with understanding.	a. Demonstrate ability to quantify information collected through investigations.	a. Demonstrate ability to quantify information collected through investigations.

2. **Record measurement using appropriate scientific notation.**

Third Grade	Fifth Grade	Eighth Grade
a. Express large and small quantities as powers of 10.	a. Express large and small quantities as powers of 10.	a. Express large and small quantities as powers of 10.

3. **Identify and demonstrate a relationship between two variables that can be used to make a prediction.**

Third Grade	Fifth Grade	Eighth Grade
a. Determine the nature of graphic representation needed to express a relationship between two variables.	a. Identify conditions that cause or influence a change in variables.	a. Identify conditions that cause or influence a change in variables.
b. From a graph of data, make a statement about the relationships of the data from which the graph was made.	b. Determine which variables should be manipulated to investigate a given situation.	b. Determine which variables should be manipulated to investigate a given situation.
	c. Identify variables which are manipulated or responded to, and constants in an investigation or an experiment.	c. Identify variables which are manipulated or responded to, and constants in an investigation or an experiment.
		d. Demonstrate ability to convert quantitative data into other useable forms.

4. **Read and interpret numerical values from charts, tables, or graphs, and apply results to answering questions.**

Third Grade	Fifth Grade	Eighth Grade
a. Identify trends of outcomes from data on a graph or chart.	a. Identify trends of outcomes from data on a graph or chart.	a. Determine which variables should be manipulated to investigate a given situation.
	b. Identify conditions that cause or influence a change in variables.	b. Identify conditions that cause or influence a change in variables.

M. **Recognizing Impacts. The student shall:**

1. **Identify, describe, and discuss contemporary issues in science, such as family planning, patterns of socially transmitted diseases, genetic engineering, pesticides, nuclear energy, and pollution as they relate to humans.**

Third Grade

a. Manage his/her personal environment in an effective manner.

b. Recognize the interactions among science, technology, and society.

c. Distinguish between fact and superstition.

Fifth Grade

a. Select cause-and-effect relationships to explain contemporary problems.

b. Describe the direct and indirect role of individuals on the quality of the environment.

c. Describe the impact of various industries on the environment.

d. Distinguish between fact and superstition, fad and reality.

e. Examine in a critical manner print and non-print coverage of science issues.

f. Select an environmental problem, investigate alternative solutions to that problem, select one alternative, and defend that selection.

Eighth Grade

a. Select cause-and-effect relationships to explain contemporary problems.

b. Describe the direct and indirect role of individuals on the quality of the environment.

c. Describe the problems of industries which cause changes in natural environments and describe the social reactions to these changes.

d. List the major pro and con arguments for the further development of nuclear power.

e. Identify factors which contribute to air pollution and their impact upon the atmosphere.

f. Demonstrate an interest in the environment by seeking knowledge about environmental studies or by joining organizations concerned with environmental matters.

g. Explain and evaluate some effects of technology (e.g., inventions and methods of production on the relationship between human beings and physical environment).

M. Continued

2. **Recognize the role of the political process in the advancement of science.**

Third Grade	Fifth Grade	Eighth Grade
a. Describe how human traits influence strengths and limitations of scientific inquiry.	a. Describe the cooperation needed among groups and individuals for scientific endeavors.	a. Describe the effects of social, economic, governmental, and societal actions on science and technology.
	b. Describe how the political process, interacting with science and technology has enabled people to recognize their interrelationships with the environment.	b. Recognize that physical and biological resources serve as constraints which shape cultures.
		c. Recognize that controversy exists concerning control versus non-control over what basic research scientists should conduct.
		d. Recognize that controversy exists concerning controls versus non-controls over what applications technologists should be allowed to make using scientific advances.
		e. Identifies factors such as funding, time, preparation, resources, and effort that influence scientific achivement.

3. **Describe the effects of science in: consumerism, safety, careers, computers, solar energy, synthetic fuels, and fossil fuels.**

Third Grade	Fifth Grade	Eighth Grade
a. Use scientific knowledge and skills in everyday situations.	a. Use scientific knowledge and skills in everyday situations.	a. Use scientific knowledge and skills in everyday situations.
b. Make consumer decisions based on findings of scientific research.	b. Identify individuals and groups whose efforts, ideas, or inventions have significantly affected the lives of other human beings and describe their influence.	b. Describe the interdependence of science, technology, and the economy in terms of their processes, growth, and and development.
	c. Discuss attitudes which contribute toward living in harmony with the environment.	c. Be aware of the application of science to everyday life in the areas of consumerism, safety, careers, and computers.
		d. Recognize relationships between specific rapid changes in technology and their impact upon society.
		e. Use scientific knowledge, conventions, and skills in exploring career options.

M. Continued

4. **Recognize the limitations of science.**

Third Grade	Fifth Grade	Eighth Grade
a. Identify areas where science may or may not have an influence.	a. Identify areas where science may or may not have an influence.	a. Use scientific knowledge and processes to distinguish between science and pseudo-science.

5. **Recognize the impact of the accumulation of new evidence on scientific thought.**

Third Grade	Fifth Grade	Eighth Grade
a. Recognize different stages of advancement in scientific endeavors.	a. Recognize different stages of advancement in scientific endeavors.	a. Describe situations in which the moral and ethical beliefs of the individual determine the way in which science and technology are applied. b. Recognize the tentativeness of scientific "truth."

6. **Recognize how the contributions of science lead to the development of new ideas.**

Third Grade	Fifth Grade	Eighth Grade
a. Identify individuals and groups whose efforts, ideas, or inventions have significantly affected the lives of other human beings and describe their influences.	a. Identify individuals and groups whose efforts, ideas, or inventions have significantly affected the lives of other human beings and describe their influences. b. Distinguish between science and technology.	a. Give examples where technologists have had positive and negative influences on societal decisions. b. Distinguish between science and technology. c. Give examples where scientists have had positive and negative influences on societal decisions. d. Recognize the fundamental assumptions of causality and regularity that underlie scientific work.

M. Continued

7. **Recognize the truth seeking nature of science.**

Third Grade	Fifth Grade	Eighth Grade
a. Describe efforts of scientists to arrive at the best possible theories.	a. Demonstrate the use of scientific processes in personal decision making.	a. Distinguish between observation, hypothesis, theory, model, law, and assumption.
		b. Prefer systematic and exact explanations to non-scientific interpretations.
		c. Use scientific knowledge, conventions, and skills in exploring career options.
		d. Recognize the criteria that scientists use for judging the validity of knowledge in science (replication and public).
		e. Recognize the empirical nature of science to test hypotheses by experiment and observation after collecting data exactly, systematically, and objectively.
		f. Demonstrate the use of scientific processes in personal decision-making.
		g. Recognize the moral neutrality of science.

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